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THE KAKI OR ORIENTAL PERSIMMON

BY
I. J. CONDIT

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THE KAKI OR ORIENTAL PERSIMMON

BY
I. J. CONDIT

INTRODUCTION

The kaki or Oriental persimmon was introduced into California about 1870 and is now to be found to a greater or less extent in nearly every county in the state. The tree is easily grown, is free from serious diseases and insect pests, and is in most cases exceedingly prolific. The fruit is very attractive in appearance, ships well to both local and distant markets, and is almost universally liked if eaten in the proper condition. Why then has the persimmon remained one of our minor fruits rather than taken its place among the leading fruits as it has in Japan? Various reasons may be assigned for its lack of popularity, chief among which are the following: the general lack of knowledge among consumers as to the value of the fruit and its proper condition for eating; the failure of the growers and the marketing agencies to advertise the fruit and educate the public in regard to its proper use; the grower's lack of attention to the subject of varieties, pollination, natural and artificial ripening; the failure of growers to develop the industry in by-products such as dried persimmons. There is little doubt that persimmon culture can be made a much greater industry in California if some of the points just mentioned are carefully studied and understood.

According to the census report of 1910 there were 3,274 bearing trees in California and 8,801 non-bearing. In 1909 these produced 2,696 bushels of fruit valued at \$3,344, an insignificant item compared to the values of other common fresh fruits. That the interest in persimmon culture has considerably increased during the past decade and especially during the last two or three years is shown by the larger plantings and by the numerous requests for information regarding varieties, stocks, and cultural methods. It is difficult to determine the present acreage since the trees are scattered in small plantings. Commercial orchards are located at Oroville, Napa, Vacaville, Newcastle, Penryn, Lemon Cove, Bakersfield, Sanger, Del Rey, San Dimas, Monrovia, Glendora, Los Angeles, Orange, Placentia, Riverside, and Santa Barbara. Orchards larger than any so far planted, would have been

set out this season had suitable trees been available. The fruit is shipped to eastern markets in half-car and occasionally full-car lots and is becoming better known to consumers each season. The gross returns per acre in favorable locations show a handsome profit when compared with the returns from some other deciduous fruits. While it may not be wise to develop any extensive acreage of persimmons which might tax the capacity of the markets, a steady increase is certainly justified in view of past experience.

HISTORY (7)*

The persimmon is an important fruit tree both in China and in Japan. In northern China certain valleys are entirely given over to its cultivation while on the main island of Japan groups of the trees are found in every village along the roadsides or in odd corners around farmer's cottages.

It is probable that the first trees of the kaki grown in North America were from seeds obtained in Japan and sent here by Commodore Perry in 1856; these were planted at the Naval Observatory in Washington, D. C.

The first fruits were produced on these trees in 1860. No seedlings, however, were distributed and none propagated, and the old trees died. Mr. Wm. Saunders of the Department of Agriculture imported a lot of seeds from Japan in 1863. The seedlings were distributed for trial and one tree at least bore about a bushel of fruit. In 1870 the Department imported a lot of grafted trees of named varieties, which were distributed in California and the Gulf States. The Hachiya, Tane-nashi, and Yemon were among the first varieties to be established and the nomenclature determined. Since that time a large number of importations have been made, not only by the Department but by nurserymen and growers and widely disseminated throughout the Southern States and in California.

In 1877 it was stated in the *California Horticulturist* (2) that "there can be no doubt of its being successfully cultivated in most parts of California and it has already fruited with large and handsome specimens at Col. Hollister's place, Santa Barbara. Its average weight given is from half a pound to over a pound. Four varieties have been lately introduced into California, both in the south and at Santa Barbara." It was also introduced into San Francisco by the Rev. Henry Loomis at Trunbull's Seed Store, 421 Sansome Street, where specimens of tree and fruit were exhibited.

*Numbers in parentheses refer to bibliography.

The Rural New Yorker noted about the same date that this persimmon was sent to the United States by Mr. Thos. Hogg about ten years previous and was being offered by nurserymen east as well as west.

Yearly importations of trees from Japanese nurseries were made by the United States Department of Agriculture and in 1878 a large consignment was widely distributed in California. During the next twenty years the demand for trees stimulated nurseries especially in the Southern States to propagate the persimmon and the importations by the Department were greatly curtailed. The introduction of promising varieties however, has continued until the present. Largely as a result of the explorations of the late Frank Meyer in China, some valuable varieties have been secured from that country while some choice, non-astringent varieties have been introduced from Japan. These have been grown and tested at the Plant Introduction Gardens, Chico, and are available to growers who desire plants for trial.

The California Agricultural Experiment Station has tested out several varieties both at Berkeley and at the various sub-stations. It was reported as early as 1880 (4) that the persimmon ripened fruit at Berkeley, but the fruit was of small size and astringent. There was on hand an assortment of twenty varieties in the nursery. At the Jackson sub-station the trees were found to be healthy, hardy, and seemed to be perfectly adapted to the poorest soils. They made a brilliant display of color for several months as the fruits hung on the trees until late in winter. It was thought at the time to have little commercial value although it was considered excellent for home orchards.

The few trees which were set out in orchards, however, proved profitable as shown by the following report from a grower at Auburn in 1908: "Commission merchants in San Francisco have had repeated calls from Hawaii for all the persimmons that they could obtain. Seattle likewise has asked San Francisco to ship them large quantities. The few that I grow, I ship by express to New York, packing them thirty in a box, (one layer) and get \$1.50 f.o.b. the depot here. I repeatedly received telegraphic orders for more. Single trees of the large variety yielded as much as \$13.75 besides the culls. It seems the variety mostly inquired for is the Maru. New York has asked me to grade them next season and pack 34, 38, 42, and 46 in cardboard cartons same as are used for eggs."

During recent years commercial importations from Japan have been made almost entirely by Japanese nurserymen in the Bay district who redistribute to other nurseries upon order. California nurseries have not, until very recently, found it desirable to propagate the trees in quantity. Since June 1, 1919, however, it has been necessary to depend

entirely upon home-grown trees as Quarantine Order No. 37 of the Federal Horticultural Board forbids further introductions from foreign countries of nursery stock capable of propagation.

Some of the most recent studies of Japanese persimmons have been made by S. Fujii, a graduate of the University of California. In 1915 he made a special trip to Japan to study varieties and collect data regarding the industry, his notes including careful illustrations and descriptions of ninety varieties seen in private as well as in experiment station orchards. He also imported a number of promising varieties, many of which are growing and fruiting at the University Farm, Davis.

In November 1918, Quarantine Order No. 21 of the California State Commission of Horticulture was amended so as to allow importation into this state from certain southern states, of dormant nursery stock of pear and persimmon varieties providing a permit is first secured from the Commissioner's office.

BOTANY

Persimmons belong to the Ebony family and to the genus, *Diospyros*, from the Greek words *Dios* and *pyros*, alluding to the life-giving properties of the fruit. The species of the genus, about one hundred and sixty in number, are widely distributed, mostly in tropical countries of both hemispheres with a few species in temperate regions. The trees produce hard, close-grained, valuable wood, the ebony of commerce being obtained from different tropical species.

The trees are either dioecious or monoecious, the staminate flowers appearing in the axils of leaves of the previous year; staminate flowers smaller than the pistillate, commonly in three-flowered cymes; pistillate flowers generally solitary; calyx four-lobed, the lobes contorted in the bud, more or less contracted in the throat, the lobes spreading or recurved; stamens sixteen to twenty-four in number inserted on the bottom of the corolla in two rows and in pairs; filaments free, slender; anthers oblong, the cells opening laterally by longitudinal slits; stamens mostly rudimentary or wanting in the pistillate flowers although perfect flowers are sometimes found; ovary usually four-celled, each cell more or less completely divided; styles four, spreading, two-lobed at the apex; stigmas two-parted or lobed; ovule solitary in each of the divisions of the cells. Fruit globose, oblong or conical, one-ten-seeded, surrounded at the base by the enlarged persistent calyx. Seeds pendulous, oblong, compressed; seed coat thick and bony, dark, more or less lustrous.



Fig. 1.—The pistillate or female flowers of the persimmon are borne singly in the axils of leaves of the present season's growth. The staminate or male flowers are commonly in clusters of three on separate twigs from the pistillate flowers. Both are at first white but fade to creamy-yellow and eventually to a dark brown.

NOTEWORTHY SPECIES

Diospyros virginiana (Common American Persimmon).—The American Persimmon is found growing wild in most of the southern states and as far north as 38° latitude. Little attention has been paid to it as a cultivated plant although several named varieties have appeared from time to time. It is best known to those who live in localities where the tree grows wild. The fruit ranges in size from 1½ to 2 inches in diameter, depending largely on the number of seeds although seedless varieties an inch in diameter are sometimes found. The popular belief that this fruit is not edible until it has been subjected to the action of frost is not entirely correct, since many of the best varieties ripen long before the appearance of frost; others never become edible being so exceedingly astringent that neither sun nor frost has any appreciable effect on them.

Sargent gives the distribution of this species as Connecticut southward to Florida and west to eastern Kansas, Oklahoma, and the valley of the Colorado River, Texas; very common in the south Atlantic and Gulf states, often covering with shrubby growth by means of its stoloniferous roots, abandoned fields and springing up by the sides of roads and fences. Descriptions of two varieties may be found in the Yearbook of the U. S. Department of Agriculture for 1907. Farmer's Bulletin 685 gives an excellent account of the native persimmon. Seedling trees are not uncommon in California, forming thickets in some neglected places; used for ornamental street trees at Bakersfield.

Diospyros texana.—This species is found in the valleys of the Colorado and Concho rivers, Texas; it is abundant in western and southern Texas. The fruit is exceedingly austere until it is fully ripe, stains black, and is sometimes used by the Mexicans in the valley of the Rio Grande to dye sheepskins.

Diospyros ebenaster.—This is the ebony persimmon of Mexico, the fruit of which is quite black so that unpoetical observers have likened the pulp to axle grease. It is excessively sweet to most tastes but because of its novelty and the ease of its culture, it is certain to be propagated. It is known in Mexico as Zapote negro.

Diospyros lotus.—The lotus persimmon grows wild here and there in the mountains of northern China. According to Meyer, it seems to love protected rocky situations in ravines along small mountain streams. The trees are often in the nature of large shrubs while in deep soils they develop into good-sized trees which are very productive. The branches are literally covered in the autumn with small blackish fruits, the size of large cherries, which are edible when soft, although the three to five seeds leave little space for flesh. The fruit is sold in China in quite large quantities, being frequently offered at railway stations to travelers.

It is stated in the California Station Report for 1882 (5) that *D. lotus* does exceedingly well in California. It was noted to be a fine ornamental tree marked by foliage of a dark bluish-green color with a peculiar luster.



Fig. 2.—The persimmon tree is very easily top-worked by the ordinary cleft graft. These scions show one year's growth on a four-year-old American persimmon root.

The trees of the lotus persimmon are dioecious, the male flowers being found on separate trees from the female. Fruiting specimens are to be found at Chico, Niles, Elk Grove, Placentia, Orange and Santa Ana. At the old N. D. Pierce Gardens and at a neighboring place, Santa Ana, the fruits, though abundant, are always seedless on account of lack of pollination. Seeds are in considerable demand for propagation purposes.

Diospyros kaki (Kaki or Oriental Persimmon).—This species has been cultivated in China and Japan for hundreds of years and is now as common in those countries as the apple is in the United States. Since

it is the only species of the genus which is being grown commercially in California the remaining part of this bulletin, unless otherwise stated, will refer to this species.

The characteristics of the flowers and fruits of the persimmon must be thoroughly understood in order to appreciate some of the difficulties incident to crop production and the peculiarities of the fruit when produced. It has long been known, especially in Florida and other southern states, that persimmon trees often fail to set fruit, although an abundant crop of flowers is produced. The trees may produce a good crop one season and the next season fail entirely although climatic conditions were quite identical. In 1909 (18) H. H. Hume called attention to the fact that non-fruiting was due to lack of pollen.

Seedling trees are very unreliable in the production of blossoms, bearing male flowers during the first few years, then a small proportion of female flowers, while later the appearance of male flowers is sporadic on some trees and regular on others. Both male and female flowers are borne on shoots of the current season, the male flowers being found singly or in two to three-flowered clusters on small weak twigs while the female flowers are borne singly in the axils of leaves on neighboring shoots. Perfect flowers are occasionally found among the normal male flowers, usually occupying the central position in the cluster of three. Both kinds of flowers are yellowish-white during the first days after opening but eventually they fade and change to a purplish-brown color. The flower stalks are persistent remaining on the tree during the winter and often for months longer.

Pollination may or may not be necessary for the setting of persimmon fruits. In Florida the presence of staminate flowering trees near the pistillate trees seems to be necessary, bees and other insects taking care of the pollination. According to Hume (25), "In some localities pollenizers may not be necessary, under other conditions the planting of them is an absolute necessity, making, as it does, the difference between success and failure in securing crops of fruit and in all cases the presence of pollenizers is an insurance against unfruitfulness." In California, on the other hand, the tendency of trees of most varieties is to overbear and we have little evidence which would lead us to advocate the planting of staminate-flowering trees to induce fruitfulness in commercial orchards. The failure of individual trees to hold their fruits may be due to lack of pollination although isolated trees bearing prolific crops are not uncommon. In Orange County a young orchard of Hachiya trees which bear only pistillate flowers, produces excellent crops, all the fruit being seedless. This persimmon is comparable in a way to the Washington Navel orange, which is grown to perfection in California without pollination of the flowers.

Certain varieties of *D. kaki* bear both staminate and pistillate flowers. Some bear staminate flowers regularly every time the tree blooms, while others produce them one season and not another,—in fact, are very irregular in this respect. The first class is designated by Hume (26) as *Staminate Constants* while the second class of staminate trees is called *Staminate Sporadics*. Those which produce only pistillate flowers may be referred to as *Pistillate Constants*. To this latter class belong our best Oriental persimmons, the Tanenashi, Hachiya, Hyakume, Tamopan, and Tsuru. Among the *Staminate Constants*, two kinds, New Sien and Siang, have been found, both having been secured in China by Meyer. The Yeddo Ichi, Maru, and a few other varieties not definitely named bear staminate flowers regularly in California. The tree referred to under S.P.I. No. 41456* is probably only one of numerous specimens scattered over California.

The effect of pollination upon the characters of the fruit is interesting and of considerable practical importance. Some fruits have dark, reddish-brown or cinnamon flesh which is non-astringent when firm; others have light flesh which is generally astringent until soft, while still others have a mixed proportion of light and dark flesh in the same fruit. Seeds always accompany the dark flesh while the light-fleshed kinds may or may not be seedless. The amount of dark flesh is governed by the number and position of the seeds. The presence of one seed usually causes a darkening of the flesh adjoining the seed, while two contiguous seeds may cause the flesh of one half the fruit to be darkened; two seeds on opposite sides of a small fruit may cause the whole flesh to become dark.

A Japanese writer has classified the varieties into sweet and astringent groups, a classification which is entirely unsatisfactory, for when varieties in the sweet group are seedless they fall into the astringent group. In 1904 (13) Hume classified the varieties of *D. kaki*, known at that time, into three groups, viz.: light-fleshed, mixed-fleshed, and dark-fleshed varieties. This system of classification is also unsatisfactory since color of flesh has been shown to be affected by pollination. The flesh characters are determined by the pollination factor and this factor finds its most striking expression in the color and texture of the flesh. All varieties of Oriental persimmons known in America are light-fleshed when seedless, while certain varieties always show darkening of the flesh when seeds are present, and other varieties are always light-fleshed when seeds are present.

*S.P.I. refers to the numbers of the Division of Foreign Seed and Plant Introduction, Washington, D.C.

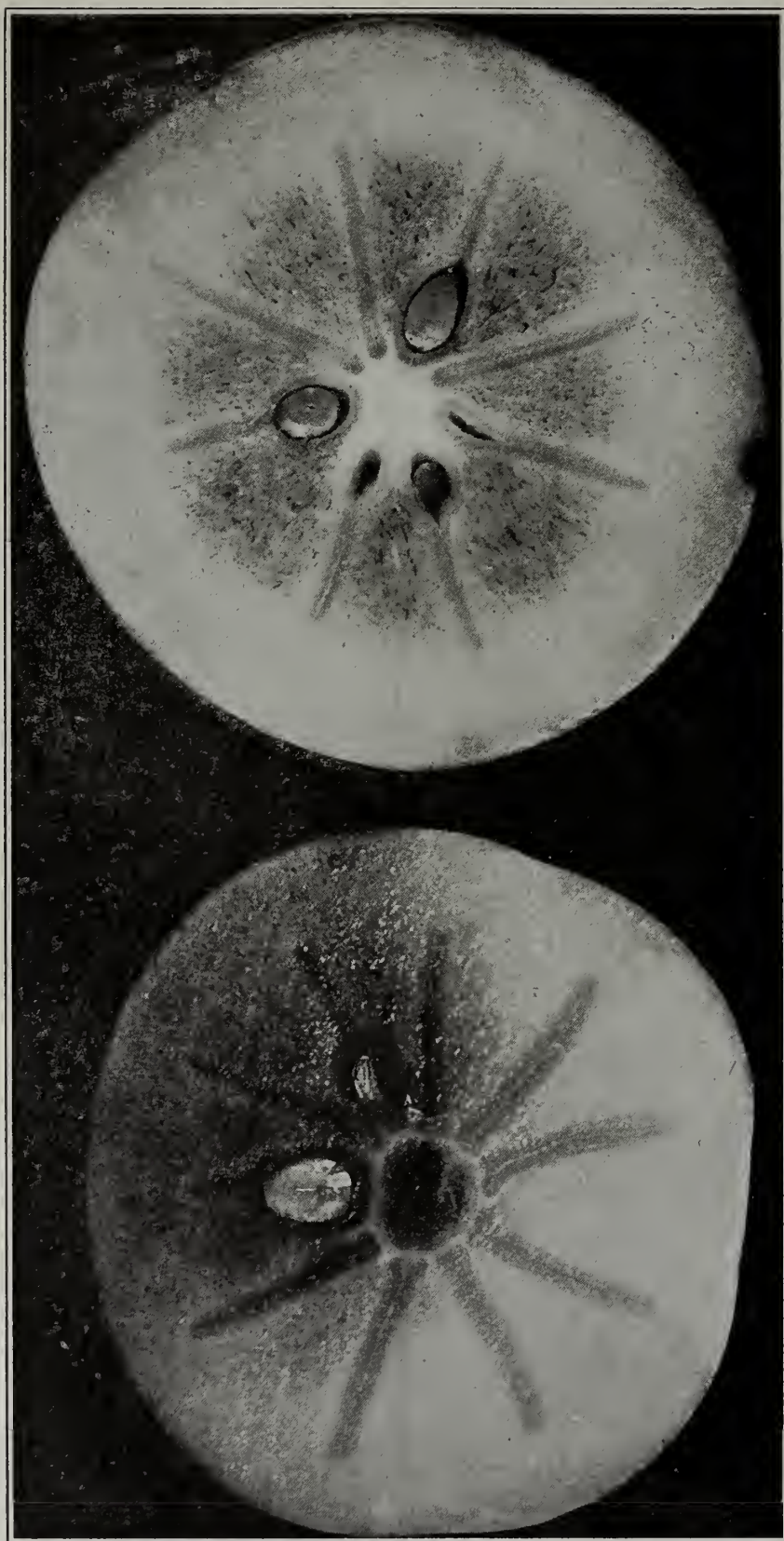


Fig. 3.—The amount of dark flesh in a persimmon depends upon the number and the distribution of the seeds. Four seeds in the Maru (above) make the entire center dark fleshed; two seeds on one side of Yeddo Ichi (below) makes only one-half the flesh dark.

Those varieties which undergo no change in color when pollinated are therefore referred to by Hume (26) as *Pollination Constants*, and those which are light-colored when seedless and dark-colored when seedy, are called *Pollination Variants*. If varieties which are constantly dark-fleshed, whether seedy or seedless should be found, the group of *Pollination Constants* might then be divided into two groups of light and dark-fleshed *Pollination Constants*.

Examples of *Pollination Constants* are Costata, Hachiya, Ormond, Tamopan, Tanenashi, Tsuru. Examples of *Pollination Variants* are Maru, Hyakume, Okame, Yeddo Ichi, Yemon, and Zengi.



SABUROSA. Natural size.

Fig. 4.—Some varieties of Oriental persimmons have characteristic protuberances or “seats” under the calyx lobes. These are especially prominent in the Saburosa, a variety found occasionally in California.

Although all varieties of Oriental persimmons so far grown in the United States are light-fleshed when seedless, there seem to be occasional exceptions to this rule. Specimens received from Oroville in December 1918 for study were entirely seedless and yet showed some cinnamon colored flesh in two of the fruits. The variety was referred to Tsuronoko but this identification was not positive.

Persimmons vary considerably in size, shape, color of skin and flesh, texture, and quality. The smallest fruit of the round type studied is the Gailey from Florida which was about $1\frac{1}{2}$ inches in diameter; the Zengi from Orange, California was almost as small. An oblong fruit known locally as “Acorn,” on account of its shape, averages $2\frac{1}{4}$ inches long and $1\frac{1}{2}$ inches in diameter. Of the conical persimmons the Hachiya produces by far the largest specimens, many of which

weigh a pound or more. Fruits of the Tamopan often average very large. Specimens of a similar variety grown at Elk Grove in 1918 were fully six inches across and nearly square.

In general, persimmons naturally fall into three groups based on shape; the conical, the round or spherical, and the flattened or oblate. Some persimmons of the flattened group show a peculiar constriction or crease around the middle or a short distance above the base, which, to use the words of Mr. Frank Meyer, who introduced them from China, "makes the fruit look as if two fruits had been joined, or as if it had been

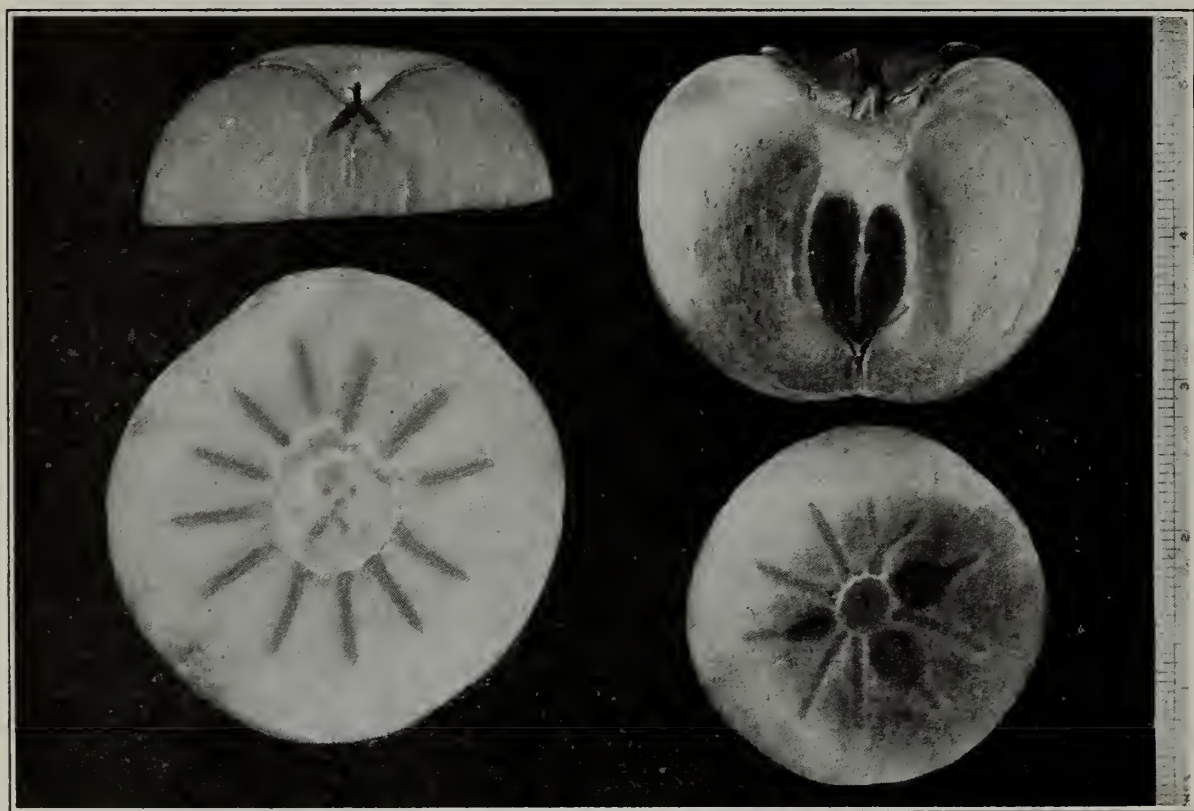


Fig. 5.—Some persimmons have a structure resembling that of a navel orange, a secondary fruit being superimposed on or within the primary.

sat upon." This constriction is very propounded in the Tamopan and a few others brought in under S.P.I. numbers, and serves as a natural trademark for these varieties. Daruma and Naga-tsuba, figured in Japanese publications show the same kind of constriction.

Various Japanese persimmons are characterized by more or less conspicuous, basal lobes or "seats" under the sepals. The following varieties figured by Japanese writers show these lobes in a more or less pronounced manner: Deinukoroshi, Futae gaki, Saburoza, Nagatsuba, Maruza or Enza-gosho and Obishi. Two of these, Saburoza and Enza-gosho have been found in California. Specimens of the Tanenashi often show more or less distinct basal lobes which are sometimes very conspicuous.

Persimmons are often creased and furrowed lengthwise by four or sometimes eight deep or shallow grooves which are usually characteristic of the variety, as in Yotsuwari and Yama Yemon, found in California and in various kinds figured by Japanese writers. Freak specimens, including double and triple fruits, are common, especially on seedling trees. The fruits of some varieties are characterized by a structure similar to that of the navel orange, having a more or less distinct secondary fruit within the primary. This is especially pronounced in the variety Futaye or Futaye-gaki, the Japanese word Futaye meaning double.

The apex of persimmons is either flat, pointed, round, or depressed, and the base projecting, flattened, or depressed beneath the calyx lobes.

Ripe persimmons are generally very attractive in color, the most fitting descriptive term being, tomato-red. Their resemblance to tomatoes is often so noticeable as to cause new comers to remark upon the wonderful tomatoes which grow on trees in California! The shade varies from a light yellowish-red in Tanenashi fruits to the very dark red of the Saburoza and the Yeddo Ichi, which color persists after ripening. Some fruits, including the Hyakume from some sections, are unattractive on account of the brownish, mottled color which develops with softening. Many varieties are characterized by the presence of fine, penciled lines encircling the apex or extending irregularly down the sides.

The flesh of most persimmons is juicy when sufficiently mature to be edible; the flesh of the Tanenashi, however, is peculiarly dry or pasty so that it can usually be recognized by this character alone.

The season for persimmons extends from October until January or even later. The fruits of many varieties, if not picked, will remain and shrivel up on the tree unless attacked by birds. Persimmons hanging on the tree after all leaves have dropped is a characteristic sight wherever the fruits are grown. The leaves themselves assume a beautiful yellow or scarlet color uncommon among other California fruit trees. A second crop of small fruits is common on the trees of certain varieties, notably the Maru and Hachiya, in Placer County.

ASTRINGENCY IN PERSIMMON FRUITS

The astringency of the unripe persimmon is generally supposed to be due to the presence of soluble tannin in cells of the fruit. The effect of this tannin is not noticeable the instant a piece of the fruit reaches the tongue as it requires a short time for the tannin to diffuse in the *saliya*; its puckery effect is then pronounced, more so in some varieties than in others, and a second taste of such a persimmon is not

usually attempted. As the fruit matures, however, the tannin becomes more and more insoluble until in a perfectly ripe specimen it is no longer perceptible. On account of this fact the astringent varieties should be perfectly soft before an attempt is made to eat them. This conception of "soluble" and "insoluble" tannin, however, is inadequate according to recent investigations. The tannin bearing cells of the persimmon are

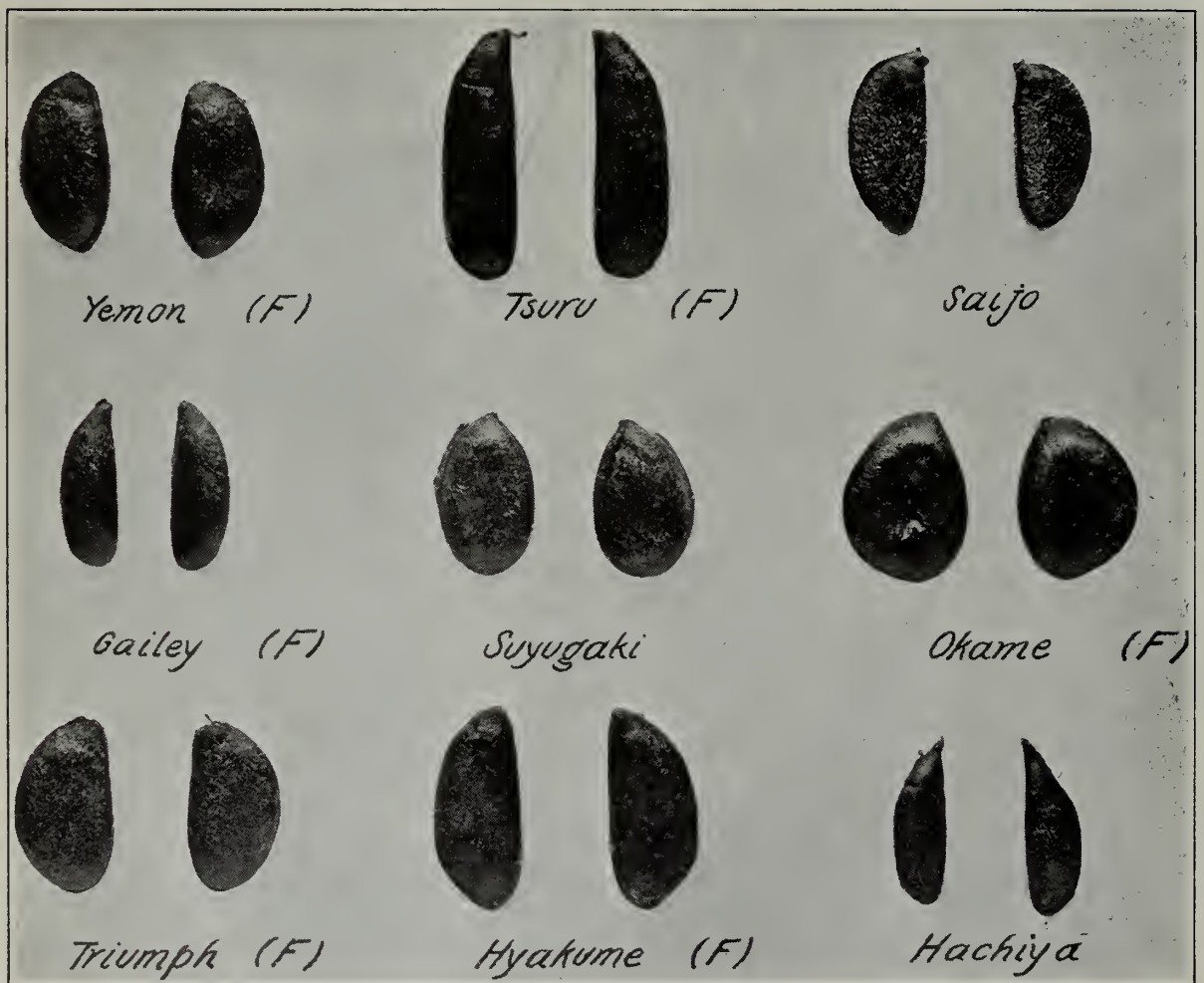


Fig. 6—The color, shape, size and surface characters of the seeds are fairly characteristic of persimmon varieties.

scattered in strands throughout the entire flesh excepting the gelatinous lining of the seed cavity. The tannin is associated with a mucilage-like carbohydrate which coagulates during the ripening process of the fruit and absorbs the tannin (20). In the fruits of some varieties the absorbed tannin becomes oxidized and red in color when the tannin masses can be readily recognized.

It can be stated in a general way that all the dark or cinnamon-colored flesh of persimmons is puckerless; the light-colored flesh may or may not be astringent. Some of the best varieties grown in Japan and China, such as the Fuyu and Tamopan, are seedless, light-fleshed and puckerless. According to Mr. Meyer the non-astringent varieties

often become astringent when transplanted to other localities. The Tanenashi, puckerless around Tokyo, becomes puckery in North Hondo. The Tamopan, puckerless in China, shows considerable astringency in some sections of Florida and California, but not in others. The Fuyu as grown in California so far is non-astringent.



Fig. 7.—Persimmon seeds. Specimens marked (F) were grown in Florida.

HORTICULTURAL VARIETIES

The identity of the different varieties of Oriental persimmons has been very much confused ever since the first importations were made forty years ago. Trees were propagated in Japan and exported under wrong labels so that often out of ten trees purchased as a single variety the grower discovered he had a half dozen or more distinct varieties and possibly none of the kind he expected. Fruits of a certain tree would be seedless one year but seedy and dark-fleshed the following year, a circumstance which added considerably to the confusion in nomenclature. The leading commercial varieties have been given names which may not, however, identify the fruit with the same variety in Japan. The satisfactory classification suggested by Hume (26) will be followed here, with the addition of descriptive terms which may be useful to the practical grower.



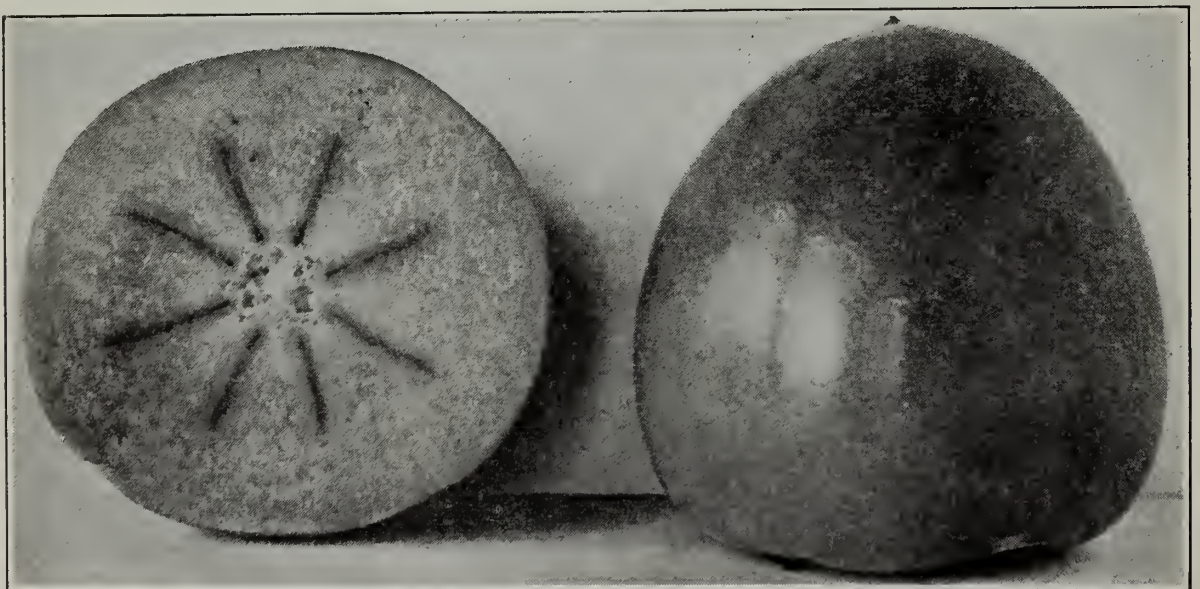
HACHIYA

Fig. 8.—The largest and finest conical persimmon grown in California is the Hachiya. It is the variety most favored by growers for commercial planting.

I.—POLLINATION CONSTANTS: Fruits always light-fleshed, whether seedy or seedless.

a.—Conical Type

Hachiya,—Fruit very large, oblong-conical, usually deep orange-red, very attractive; surface glossy; flesh astringent until soft, sweet, rich, excellent in quality; usually seedless; the leading commercial variety, although regarded as a light bearer in some sections; often bearing heavily in alternate years. Season medium. Especially fine in Orange County. Colored plate and description in the Yearbook, U. S. Department of Agriculture for 1887, p. 644. Probably identical with Fuji of Japan.



TANENASHI

Fig. 9.—Next to the Hachiya the Tanenashi is the most popular variety being grown in California at present. The flesh is peculiarly dry and pasty, but is excellent served with cream and sugar.

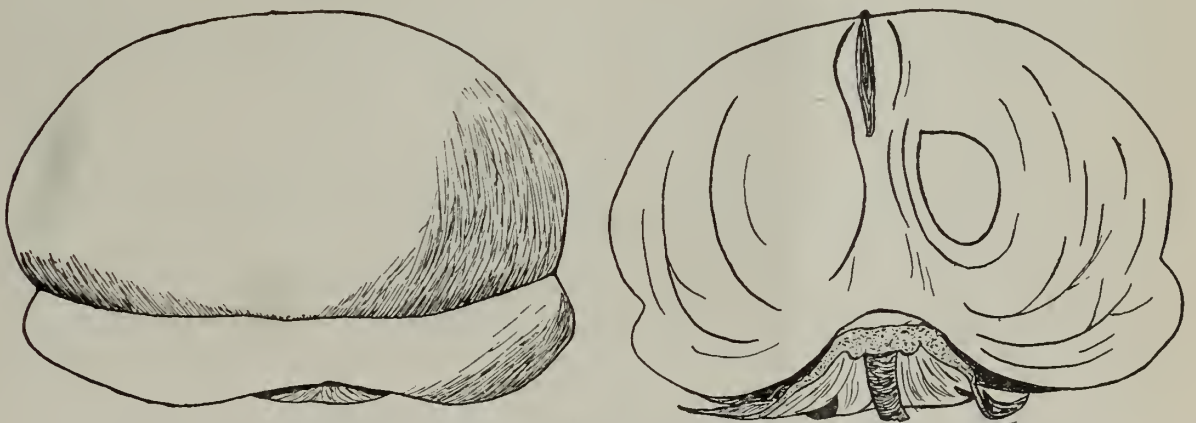
Tanenashi.—Fruit large, broadly conical, tapering gradually upward from near the base; color light orange-red; surface fairly glossy, smooth, with distinct areolations visible through the skin; flesh astringent until soft, characteristically mealy or pasty; of very good quality; practically always seedless; fruits often defective at the core, with an opening under the calyx exposing the interior to dust, dirt and mold. Season medium. Trees bear heavily in alternate years. Colored plate and description in U. S. D. A. Yearbook for 1887, p. 644.



TSURU

Fig. 10.—The Tsuru persimmon is commonly cylindrical and much longer in proportion to its diameter than any other variety. It is usually seedless and is always light-fleshed.

Tsuru.—Fruit oblong-cylindrical with rounded apex; longer in proportion to its size than any other variety; color bright orange-red, attractive; skin smooth, glossy,



TAMOPAN

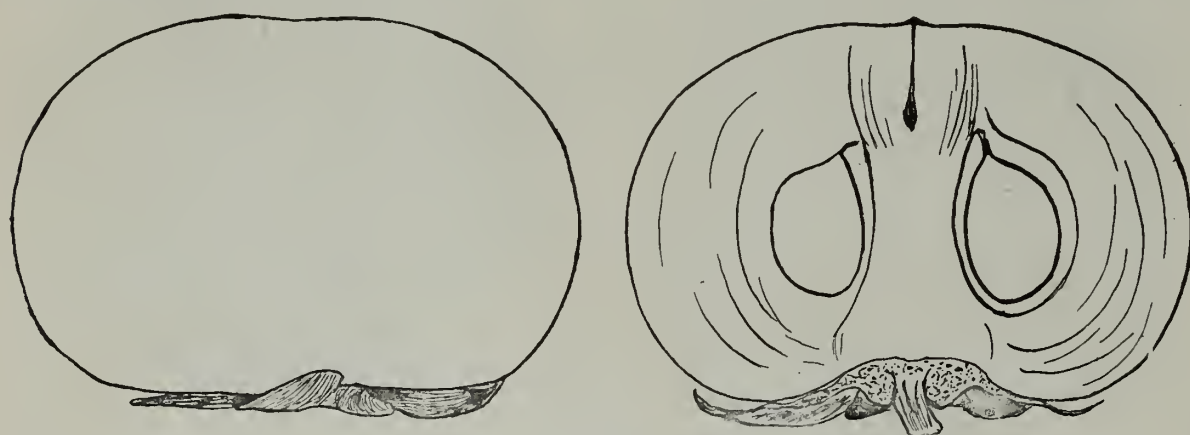
Fig. 11.—The Tamopan persimmon is peculiar in having a constriction or crease extending around the fruit equatorially. The skin is thick and firm so that one can eat the flesh with a spoon from the half shell.

rather thick, granular; flesh astringent until soft, often failing to ripen uniformly; quality good; usually seedless. Season late. Fruit especially sought after by Orientals. Colored plate and description in U. S. D. A. Yearbook for 1890, p. 423.

The Costata illustrated and described in the Yearbook for 1892, p. 265; the Ormond (Yearbook for 1912, pp. 270, 271); and probably the Yama Tsuru (Yearbook for 1891, p. 387) belong to this group.

b.—Flattened or Oblate Type

Tamopan.—Fruit very large, often three to five inches in diameter and sometimes over a pound in weight; usually more or less quadrangular with a prominent equatorial constriction or crease below the middle; color light reddish-orange changing little at maturity; skin thick and tough, enabling one to eat the flesh with a spoon from the half shell; flesh light orange, very juicy, stringy, mostly astringent until soft, fairly rich; quality very good; usually seedless. Season medium. Tree hardy, vigorous, productive. First introduced by the U. S. Department of Agriculture from China in 1905.



FUYU

Fig. 12.—One of the most, if not the most promising variety from Japan is the Fuyu which is always light-fleshed and perfectly non-astringent. Trees have been fruiting for a number of years at the Plant Introduction Gardens, Chico.

Fuyu.—Fruit medium to large, indistinctly quadrangular; color deep tomato-red, attractive; surface fairly glossy; flesh light orange, fairly rich; perfectly non-astringent even when seedless and firm; quality very good; seeds few or none. Above description refers to fruits produced on tree at Plant Introduction Gardens, Chico, imported under S.P.I. No. 26491. A very promising variety. Fruits of S.P.I. No. 32868 are very similar if not identical. S.P.I. No. 26733 has fruited in Florida and is regarded as the most promising variety yet tested. Trees of the same number have fruited at Mountain View, California, the fruits being entirely non-astringent. It was introduced under the name Fuyugaki.

Gosho.—Fruits of the true Gosho have not been studied here so far, although trees have been introduced and they may have fruited. Japanese specimens are described by S. Fujii as follows: size medium; shape oblate, with a very wide and deep cavity; color orange-red when fully ripe; flesh light, tender, very juicy and sweet; seeds few; quality the best of all sweet varieties. Tree rather a shy bearer in Japan but widely planted on account of the excellent quality of the fruit. Originated in Gosho village.

The word Gosho, like Maru, is commonly used as a suffix to variety names in Japan; thus Okugosho, signifying late; Tenjin-gosho, from Tenjin in the province of Gifu; Hana-gosho; Tokuda-gosho; and others, most of which are non-astringent.

The varieties Siang-shi-tse, grown at Chico under S.P.I. No. 21910; the Triumph illustrated in color and described in the U. S. D. A. Yearbook for 1913, pp. 119, 120; and the Maruza or Enza-gosho found in the Trapp orchard at Los Angeles, belong here.

II.—POLLINATION VARIANTS.—Fruits light-fleshed when seedless, dark-fleshed around seeds.

a.—Conical Type

No varieties of this type are commonly grown in California. The variety known locally in Placer County as "Acorn," probably identical with the Japanese variety Sokyū, belongs here; also Tsurunoko grown in various parts of the state.



Fig. 13.—The size of persimmons depends upon the amount of fruit on the tree, the fertility of the soil, and the available supply of moisture. The shape, however, is characteristic of the variety as a rule.

b.—Round or Spherical Type

Hyakume.—Fruit medium to large, mostly four-angled; color light orange, often mottled or dappled and unattractive at maturity; brown when soft; surface glossy, usually with fine russet lines around the apex and down the sides; flesh dark cinnamon color when seeded, sweet, moderately rich; quality very good; keeping quality excellent. Season medium. Colored plate and description in the U. S. D. A. Yearbook for 1889, p. 450.

Maru.—Fruit medium with a broad, rounded apex; color orange-red, attractive; surface somewhat glossy, with heavy bloom; flesh dark cinnamon when seeded, very sweet, rich; quality excellent. Tree a regular heavy producer in Placer County; season medium.

The name Maru, meaning round, is used as a suffix of several variety names such as Zengi-maru, Daidai-maru, and Sagami-maru, signifying that the fruits have a general roundish form. The name should properly be used therefore as a type rather than a variety name. The same is true of the name "Kineri."

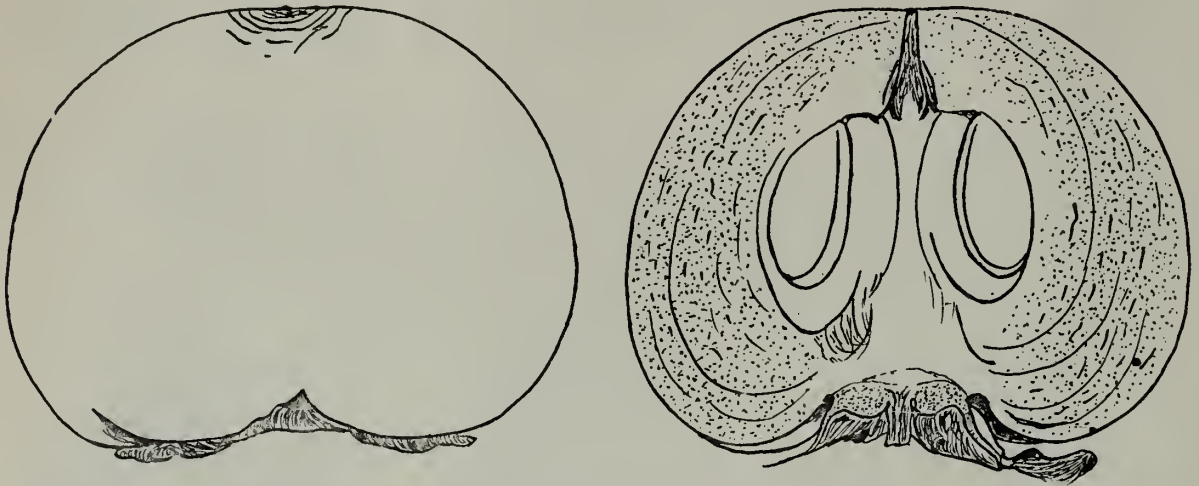
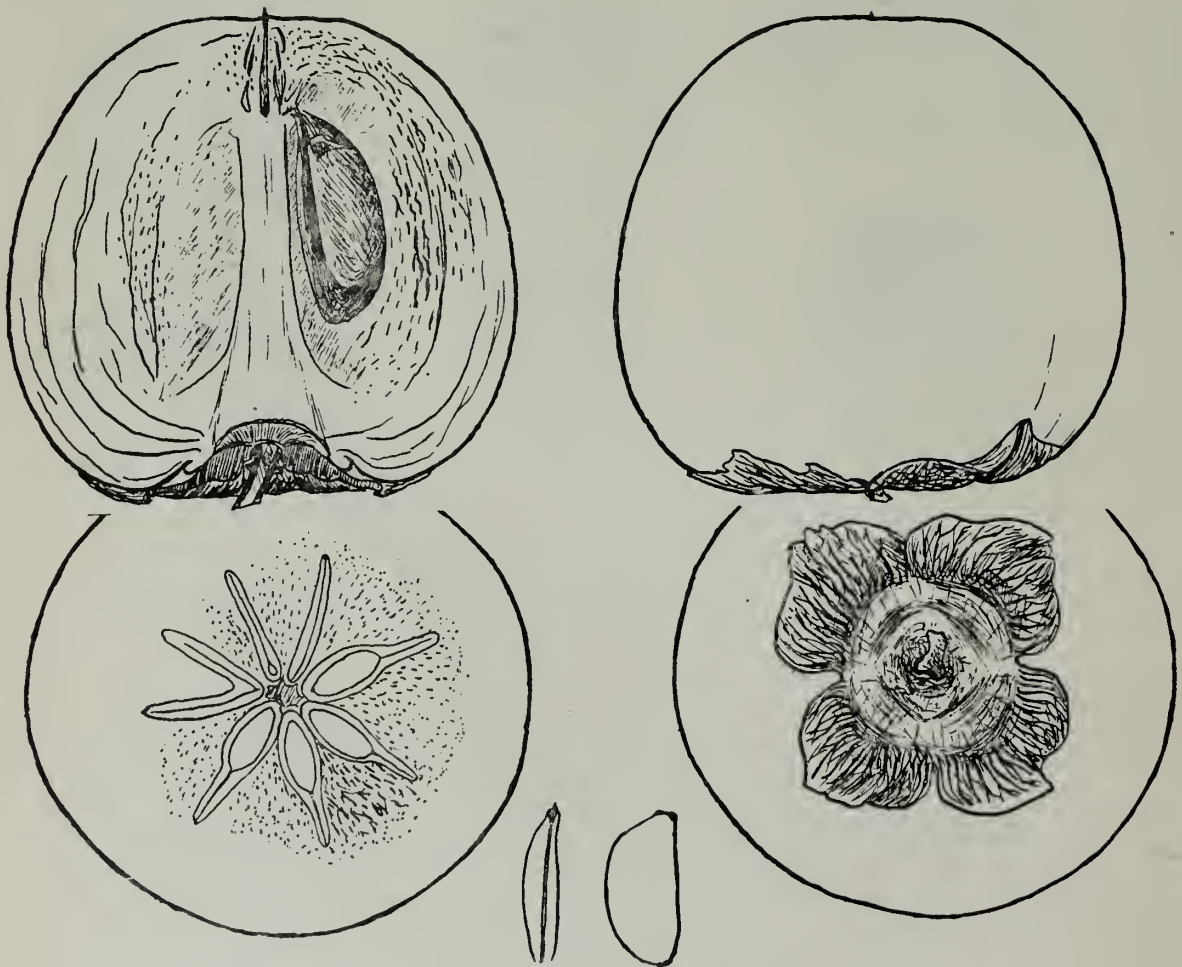


Fig. 14.—Fruits of the Hyakume are generally large, dark-fleshed when seeded and of good quality but unattractive in color and appearance when thoroughly ripe. The trees are prolific, however, and the fruits keep remarkably well. The variety is favorably regarded for commercial planting, especially in Placer County.



MARU

Fig. 15.—The word "Maru" signifying round, is a common suffix to variety names in Japan. It should properly be used to designate a type rather than a variety. Trees grown under this name are common in Placer County.

Saburoza.—Fruit small to medium, characterized by four prominent lobes or “seats” extending beyond the calyx; color very dark tomato-red, very attractive; surface glossy; flesh very dark cinnamon when seeded, sweet, rich; quality excellent. Illustrated and described in the *California Cultivator*, January 28, 1915.

Zengi.—Fruit small; color dark orange-red, attractive; surface, glossy, often marked by russet lines around the apex; flesh very dark, almost black when seeded, sweet, rich; quality very good. Season early. Fruit too small for commercial use. The Gailey, Taber's 129, and Myotan, grown in the southern states belong to this group.

c.—Flattened or Oblate Type

Yeddo Ichi.—Fruit often more roundish than flattened, medium, apex slightly depressed at center; color very dark tomato-red, attractive; surface somewhat glossy, usually marked with fine pencilled lines around the apex; flesh very dark cinnamon when seeded, sweet, rich; quality excellent. Colored plate and description in the U. S. D. A. Yearbook for 1889, p. 450.

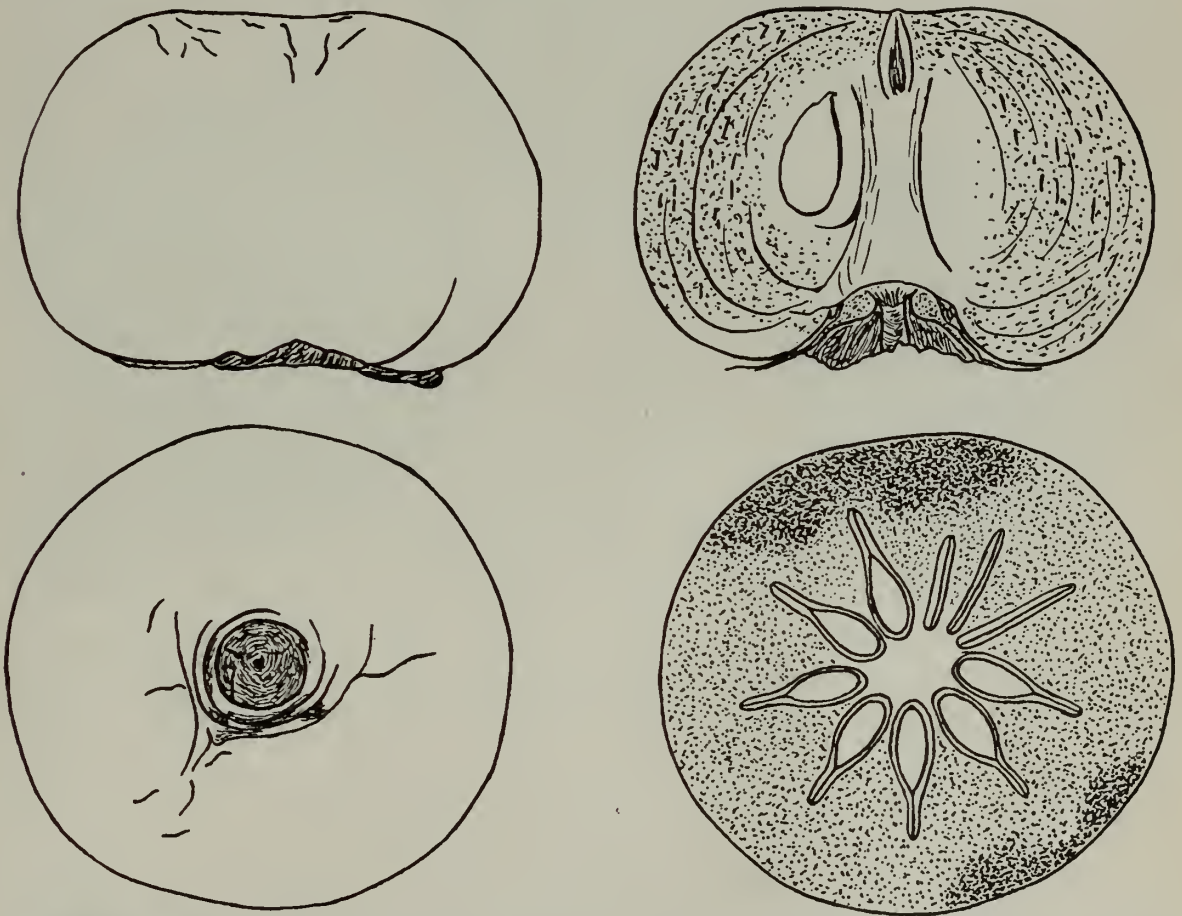


Fig. 16.—The *Yeddo Ichi* is a dark-fleshed persimmon of excellent quality but rather small for commercial planting. The pencilled lines around the apex are characteristic of seeded specimens.

Yemon.—Fruit medium, decidedly flattened and quadrangular; color light orange-red; surface somewhat glossy with a heavy ashy-gray bloom; flesh cinnamon when seeded, sweet, fairly rich; quality good. Season, late. Tree a very heavy, regular producer. Seedless specimens illustrated in color and described in the U. S. D. A. Yearbook for 1887, p. 644.

The *Yama Yemon* is very similar to the *Yemon*, but generally larger, earlier, and often furrowed on the four sides.

The variety Dai Dai, illustrated in color and described in the U. S. D. A. Yearbook for 1891, p. 386, is seldom found in California. It is grown at Chico under S.P.I. No. 13835.

The Okame, described in various publications, and grown in many sections under the name "Mikado" belongs here.

The Yotsuwari, grown at Newcastle has four very distinct creases or furrows extending upwards from the base dividing the fruit into four fairly even sections.

The following varieties may be classified here: Godbey, grown at Chico under S.P.I. No. 29329; Suyugaki, at Chico under S.P.I. No. 27034; Kurokuma at Chico under S.P.I. No. 13841.



Fig. 17.—The Okame, often known locally as the Mikado, is one of the most common varieties on the San Francisco market in the fall of the year. The trees are very prolific and the individual fruits are consequently small in size.

CLIMATIC AND SOIL REQUIREMENTS

Many of the first Oriental persimmon trees brought to the eastern United States were killed by the winter's cold, and the early accounts of the experimenters with trees showed conflicting reports regarding their hardiness. The tree is not hardy at Washington, D.C., although occasional trees protected by buildings may be found as far north as New Jersey. In the eastern states this class of persimmon can not be grown successfully much north of Raleigh, N.C. The tree of the Tamopan which has been reported as surviving temperatures several degrees below zero, seems to be injured as readily as trees of other varieties grown in the southern states. Various accounts, however, show

that both in Japan and China persimmon trees are grown successfully in regions where zero temperatures or lower are not uncommon and where considerable snow covers the ground in winter. In general, it can be stated that the northern limit of successful growth is about the same as, or a little beyond that of fig trees. Successful fruiting of the fig requires considerable summer heat and dry atmospheric conditions which accounts for the poor success with figs in the immediate vicinity of San Francisco Bay. Persimmon trees, however, produce well along the coast, neither the foliage nor fruit seeming to suffer from high humidity or cool nights; the season for the fruit in coast districts is naturally later than in the interior valleys. Lateness is no disadvantage however and may be a distinct advantage in marketing the crop if it can be held until other fall fruits are mostly shipped.

Persimmon trees thrive and bear excellent crops in the hot, dry valleys of the interior. It is reported, however, in Circular 159 of this station that persimmons are sensitive to the dry heat of Imperial Valley and young trees, if not protected, are easily killed by sunburn. Mature trees in Imperial Valley have borne fine fruit, which seem to lack the extreme astringency found in the unripe fruit elsewhere.

The blooming season of the tree is sufficiently late to escape late frosts. It is recorded, however, in the California Experiment Station Report for 1897-8 (11) that the persimmon crop was a failure in 1898 at the Jackson Sub-station on account of frost damage to the flower buds. Twice during the last ten years there has been some frost injury to persimmon flowers near Newcastle but not enough to destroy the entire crop.

Broadly speaking, the best soil for the Oriental persimmon is a sandy loam of open texture with a fair amount of humus and good drainage. In California we find that on the heavier soil types the persimmon grows more vigorously and taller, while on the light sandy soils the growth is more moderate or even dwarfed with heavy fruitage. The fact that trees are thriving in a wide variety of soils and situations in California, shows that they are not particular as to soil types. The trees are often planted along ditches and streams where they often do well even when neglected. The current idea that the persimmon tree thrives on low, wet soils should not be carried to such an extreme as to plant orchards on swampy, poorly drained land where spring cultivation is impossible as it is doubtful if their culture would be profitable under such conditions.

PROPAGATION AND STOCKS

An excellent account of the propagation of the native American persimmon is given in Farmer's Bulletin 685, U. S. D. A., published in

1915 and some of the methods are applicable to the Oriental persimmon. In the southern states, the kaki is said to be much more thrifty and vigorous on seedlings of the native persimmon than upon its own roots.

Some nurserymen use root-sprouts of the American persimmon for stock in spite of the fact that they are less productive than seedlings and also harbor the root sawyer insect. The general practice is to graft just at the surface of the ground and draw earth high up over the juncture. One method of propagation is to dig up, root graft, and callus over, almost precisely as in root-grafting the apple. In central and southern Florida dormant budding has been favored.

The American persimmon stock has the fault of sprouting wherever the roots are broken by tillage tools and in Texas it is considered one of the most difficult tasks to clear a piece of land of native persimmon trees as every little piece of root left will send up a sprout. Apparently no serious difficulty has been experienced either in Texas or Florida however, with the suckering of the native stock in the orchard.

Some nurserymen in California gather seed from trees of *D. Virginiana* which fruit abundantly in some places, and work the commercial varieties on stock grown from these seeds. Aside from the fault of sprouting the American persimmon makes an excellent stock in California.

Experience in Texas indicates that seedlings of *D. texana* are not satisfactory for stocks.

Diospyros lotus as stock.—According to Meyer (21), all the persimmons in northern China are ring-budded or grafted upon a species growing wild in the mountains. "As a stock, this persimmon may give to its grafted host a much longer life than the native American persimmon seems to be able to, for in China all the cultivated persimmons grow much older than they do in America. Of some varieties there, one finds trees grafted on this *D. lotus* that are centuries old and still very productive."

Experience in Florida has shown that the lotus stock is not satisfactory there, the roots rotting off in damp soils.

Trees of the lotus persimmon have long been fruiting in California but the seedlings have not been largely used for stock until recently. As early as 1882, (5) however, the California Experiment Station reported that as a grafting stock it had an advantage over the American on account of a far better root system. The *D. kaki* root has proved unsatisfactory at Riverside, not over one-third of the original planting having survived; the young trees on the lotus root are growing thriftily.

The lotus stock is preferred at the Plant Introduction Gardens, Chico, as it has a better root system, is much easier to transplant on account of the numerous fibrous roots, and does not sucker in the orchard.

A successful propagator near Placentia uses the following methods with the lotus stock: The seeds of the *lotus* (often called Manchurian and sometimes Italian) are stratified in sand one inch deep, covered with oiled paper and kept in a cool place until spring, when they are planted out in nursery rows. It is very important to shade the seedlings from sunburn as they are coming out of the ground. The sprouting is similar to that of beans, the cotyledons being pulled out of the ground by straightening of the arched hypocotyl which is the tender part. The seedlings are thinned out or transplanted so as to stand six to eight inches apart in the row and each is shaded at the base, usually with a lath. A few of the largest seedlings may be budded in late summer or fall but grafting in late winter and early spring gives best results. A shallow trench is dug along one side of the row and the larger seedlings cleft-grafted, the smaller whip-grafted. The scions grow rapidly during the following season and the nursery trees are sold at one year of age.

ORCHARD MANAGEMENT

Planting and Care.—Some varieties, such as Costata and Maru, are upright in habit and require less space than those of spreading habit like Tanenashi and Hachiya. The trees may be set in February or March as close as 20 feet, although in rich deep soil, 24 feet is better. The deep tap root of the American persimmon makes careful work in transplanting a necessity. The trees should be transplanted when young if on American persimmon root. Since the trees are deciduous, balling is not necessary when moving them from the nursery to the orchard, but the bare roots should be protected from drying out by means of wet straw or sacking. All mangled or injured roots should be cut back to sound tissue and any showing root-knot or crown-gall should be discarded and burned.

The care of a persimmon orchard will not differ much from the care of other deciduous orchards. Where the rainfall is less than twenty inches the trees require irrigation water in amounts sufficient to produce vigorous growth and to bring the fruit to maturity. Cultivation and fertilization will have to be regulated to meet the existing soil conditions.

Pruning and Top-working.—Persimmon trees which are unpruned and the fruit of which is not thinned have the habit of bearing in alternate years. Two villages near Tokyo, Japan, have for a long time co-operated in a curious manner to lessen and regulate the yield in order to avoid glutting the market. In one of the villages the growers ventured to practice the removal of the young flowers in the fruiting year and thus

encourage a crop in the off year. In such a way the trees in the two villages bear in alternate years.

Persimmon fruits are produced on wood of the current season. Well-matured shoots of moderate length which have remained sterile during the current season, send out fruiting wood the next season. Thus one of the main objects of pruning should be to encourage this type of growth. The Japanese method is to prune out each shoot which has borne fruit while the sterile or non-fruited ones are either left unpruned or are cut back so as to fruit the following season. This is often done at the time of gathering the fruit, especially with the astringent varieties the fruits of which are peeled and cured in the sun.

In California the young trees should be headed at about 36 inches and then the four or five main branches should be properly spaced over the upper 12 inches of trunk rather than have them bunched near the top. It is important to develop a strong system of main branches during the first three or four years so that less trouble will be experienced later in propping the branches and keeping them from breaking down with the weight of the fruit.

It is no more difficult to top-work persimmon trees than other common fruit trees. According to Hume (25) "it is quite easy to bud over branches here and there in properly placed trees. No preliminary cutting back is necessary as the buds may be inserted where the bark is anywhere from one to three years old. The work should be done just as the leaves are coming out in spring, using the ordinary method of shield budding and tying the buds in place with waxed cloth. The wraps should be left on about three weeks and as soon as the buds have taken, the branches should be cut back, leaving stubs five or six inches long to which the shoots from the buds may be tied as they grow out. These stubs should be removed at the end of one season's growth."

In California budding has not been so satisfactorily or so commonly used as grafting. In various parts of the state the cleft graft has given excellent results especially with young trees. Scions of the desired variety are inserted in early spring in clefts of the stock, split for the purpose, and all exposed ends carefully waxed over. Should the scions fail to grow, buds may be inserted in June at the base of the sprouts which push out.

Thinning.—At present the persimmon market offers a premium rather than a discount for extra large sizes. Systematic thinning of the fruit of varieties which habitually overbear is advisable. This should be done before the fruit is half grown. Thinning also relieves the tree of its excess of fruit and allows it to store up sufficient plant food for the production of good buds for the following season. It may thus correct the habit of bearing in alternate years which is so

common with many varieties. The trees should begin to bear fruit the third year in the orchard.

Harvesting.—The fruit should not be pulled but cut from the twig with clippers. If intended for a distant market it should of course be gathered when mature, but still firm. Experience will soon enable the grower to judge the proper degree of maturity at which the fruit is ready for market. It must be well colored but not of the full color which develops as the fruit becomes thoroughly ripe. The color develops first at the apex and gradually extends toward the base, and picking should not be done until the basal half has lost most of the green color. The fruit should be carefully handled so that the surface is not bruised or injured, as such bruises develop into dark blemishes which greatly injure the appearance on the market. For home use the fruit may be allowed to become mature on the tree although it is likely to be attacked by birds when ripening. A good plan is to remove the fruit from the trees when fully matured and allow it to ripen in a cool cellar or closet. Another satisfactory plan is to place the persimmons in layers of chaff or fine straw in boxes so as to exclude the light. Such fruit will ripen in from two to six weeks depending upon the stage of maturity when picked. Fruits which are picked while immature are liable to shrivel up rather than to soften, especially if kept in a dry room.

Most varieties of persimmons now grown commercially are astringent until soft, the fruit being allowed to ripen on the fruit stands or in the home of the consumer. The dark-fleshed varieties are non-astringent when the dark-flesh is present but it is practically impossible for either the grower or the consumer to be certain that the individual fruit at hand is seedless, light-fleshed and astringent, or seeded, dark-fleshed and sweet, until the fruit is cut. The great desirability either of growing non-astringent varieties or of removing the astringency from the fruits of varieties now being grown, is evident. Methods of artificial ripening will therefore be discussed.

Processing.—Artificial ripening of the persimmon has been practiced in Japan for many years. The first reference in American literature to the Japanese method is found in the *California Horticulturist* for March 3, 1877, W. E. Griffin stating (2) that "the most luscious Japanese persimmons are ripened by air-tight enclosure in casks containing sake (a kind of beer made of rice) which in two or three weeks perfects a remarkable flavor." Reference is also made to this process in the *California Horticulturist* for April, 1879.

Dr. Knapp who introduced some Japanese persimmons into the United States in 1899 also made reference to this method of processing but curiously enough, little attention seems to have been paid to these early accounts by American growers. In 1902 Mr. Watrous of Iowa

made a trip to Japan, investigated the Japanese method, and reported to the Secretary of Agriculture the details of the process. Sake tubs or casks, in which rice beer has been stored, are used, the fruit being placed in the tubs as soon as emptied. The head of the tub is immediately replaced and the package made air-tight. In five, eight, or fifteen days, according to the temperature, the fruit may be removed in a firm, sound condition and shipped long distances, but with the astringency all gone and the flavor fine.

At the suggestion of the U. S. Department of Agriculture, Mr. Geo. Roeding of Fresno made in 1905 the first trial of this method in the United States. He reported (16) that he was astonished to see how completely the bitterness had left the persimmons, although they were just as hard as when put in the tub eleven days before.

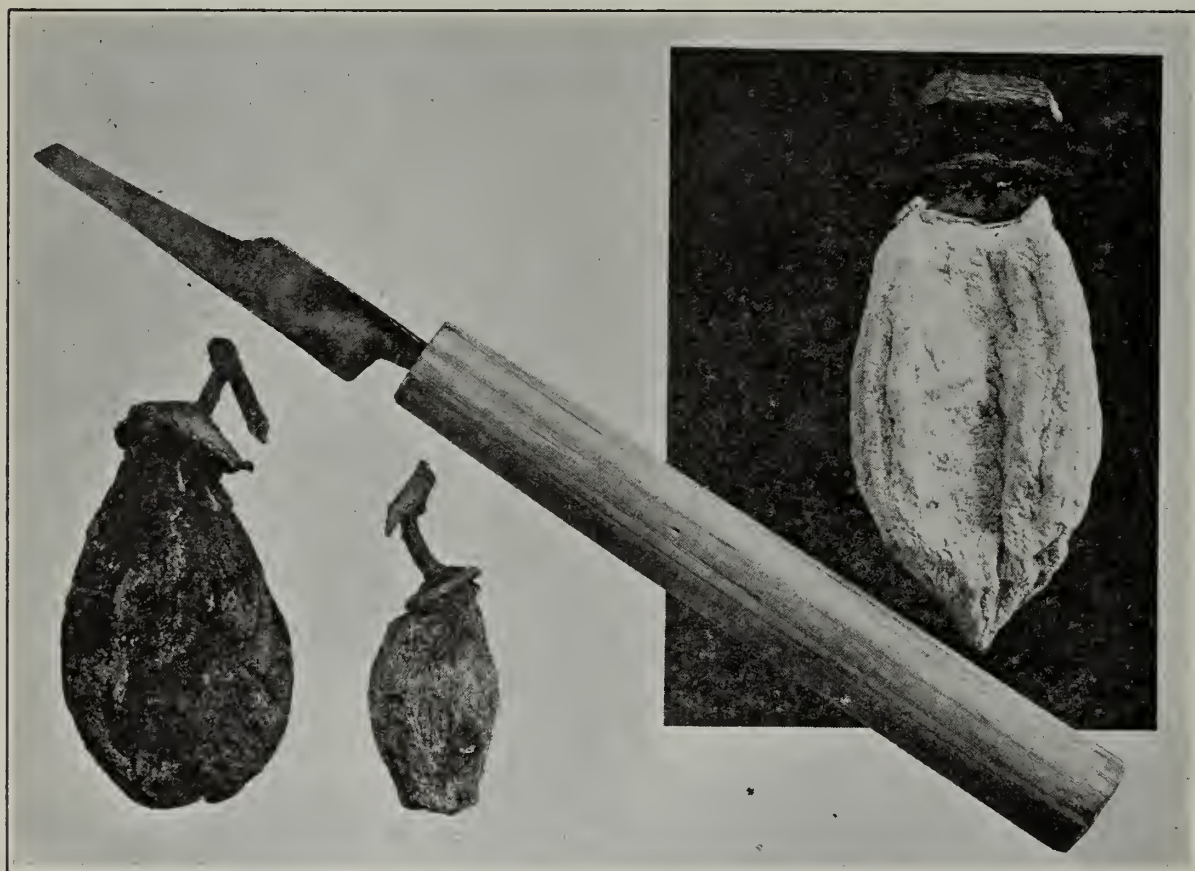


Fig. 18.—Dried persimmons are as common in Japan as dried apples in the United States. When properly dried the sugar crystallizes out on the surface, making a white, attractive product.

During the seasons from 1907 to 1910 the whole subject of the growth and ripening of persimmons was investigated (22) (23) by Messrs. Bigelow, Gore, and Howard of the Bureau of Chemistry and by F. E. Lloyd of Alabama. It was found that butter tubs whose walls were saturated with dilute alcohol were found to serve as well as sake tubs soaked with sake. A pad of paper pulp wet with 25% alcohol was placed in the upper part of each tub but the persimmons ripened

in this way softened during the process. The most satisfactory results were secured by processing in an atmosphere of carbon dioxide gas for from three to five days, the fruit becoming non-astringent while remaining firm. Churn barrels were found satisfactory containers in the south while at Washington a special metal apparatus was perfected for processing the fruit on a commercial scale. Carbon dioxide was passed into the container from a steel cylinder such as those used at soda fountains. Several varieties were processed on a large scale in Florida and subjected to a shipping test. With one exception (yellow-fleshed Zengi) processing greatly injured the naturally excellent shipping qualities of the fruit, and it was therefore regarded as practicable only for the local market. We do not know of any attempts to commercialize this process either in Florida or California.

For home or local use persimmons can be very easily and cheaply processed by either the alcohol or the hot-water method. A five-gallon milk can or an air-tight barrel with a tight-fitting cover makes a convenient receptacle. Grain alcohol, one pint to a 64-gallon container should give good results. Hachiya and Tanenashi persimmons thus processed in 1916 at Newcastle by Japanese growers were perfectly sweet, excellent in quality, and firm in texture.

Fruits immersed for twelve hours in warm water at from 85° to 105°F. will lose their astringency.

It has long been known that maturity of persimmons on the tree may be hastened by mechanical injury such as insect puncture or stabbing with a knife-blade or needle. Running a knife blade into the center of firm persimmons will cause the fruit to ripen quickly and will not ordinarily cause it to decay. The astringent fruit may also be processed by pricking it several times with a common needle dipped in alcohol and then packing in straw in a tight box or container for ten days.

Drying.—In Japan and China it is a very common practise to dry persimmons, the product forming a staple food article which is used as we use dried figs. In the U. S. D. A. Yearbook for 1915 Meyer gives an account of the extensive dried persimmon industry of certain sections of China. Sound persimmons of astringent varieties are picked with a T-shaped piece of twig attached to each fruit, and peeled by hand with a small, special knife. The fruits are then suspended on strong strings, two of which have been twisted together; beginning at the bottom the workman slips each fruit between the strings, continuing until the whole string is full of fruit. The strings are then hung in an airy room open on one side, the persimmons drying in about three weeks. They are then placed in heaps for a few days and covered with matting under which they go through a sweating process and the sugar

crystallizes on the surface. The peelings are dried separately in airy baskets. Such dried persimmons form a very wholesome article of food which is in great demand. Japanese in California have dried persimmons on a small scale but no attempts have been made to improve or commercialize the process.

Experiments on the drying of persimmons in a steam-heated evaporator are reported in Bulletin 155, U. S. D. A. Bureau of Chemistry. (23) Tanenashi fruits peeled and sliced with nickel-plated knives became non-astringent soon after placing in the drier and produced a very attractive product of excellent quality.

Packing and Marketing.—The commercial package commonly used for California persimmons is the peach box, $19\frac{3}{4} \times 12 \times 5$ inches outside measurement. When packed, these boxes average 18 pounds in weight, depending upon the size of the fruit packed. The fruits are wrapped in tissue paper and placed one or two layers deep in the boxes.



Fig. 19.—California persimmons are generally packed in the ordinary peach box having outside measurements of $19\frac{3}{4} \times 12 \times 5$ inches and averaging 18 pounds in weight. The fruits in the upper box are Hyakume; in the lower, Tamopan.

Most growers in southern California depend upon the local markets to handle their fruit. The Hachiya has been returning to the grower five to seven cents a pound during recent years. The Tanenashi does not sell well as long as Hachiya is in the market and the former are often placed in cold storage. When the two varieties are on the Los Angeles market at the same time the Hachiya brings two cents a pound

more than the Tanenashi. Some Hachiya trees at Orange bear 400 pounds of fruit annually. A grower at Monrovia harvested in 1918 from less than ninety trees about eight and one-fourth tons of fruit for which he received an average price of a little over six cents a pound. He believes the Hachiya on lotus stock should yield fifteen tons of fresh fruit per acre.

On the San Francisco Commission Market in November 1918 large Hachiya and Tanenashi persimmons were in good demand at \$1.50 per box. Tsuru, Mikado, and Maru were in poor demand at 75 cents to \$1.00 per box. The boxes in one lot consisting mainly of Mikado and Hachiya ranged from 18 to 21 pounds per box in weight.

It is interesting to note the following from Bailey's "Annals of Horticulture" for 1892: "The kaki or Japanese persimmon was this year shipped to Europe from California for the first time. Five carloads were sent East, a portion of which reached London, Liverpool, and Glasgow. Financially, the experiment does not appear to have been profitable, but it is interesting to know that so soft a fruit can be carried 6,000 miles successfully." We do not know of any such large shipments in recent years. The fruits were probably from the late Ellwood Cooper's orchard, near Goleta. In 1891 Mr. Cooper shipped persimmons to the coast markets in pasteboard cartons, like those of an egg case, each fruit being wrapped in soft paper bearing printed instructions for ripening and using.

A carload, or 1240 boxes, of persimmons grown at Santa Barbara in 1917 and shipped to Chicago sold for \$1,862.85. The freight and refrigeration charges amounted to \$369.00, leaving a net return f.o.b. of \$1,363.46, an average of \$1.09 per box. Experience of the same shipper with better varieties in good condition and properly graded shows that sales will generally average \$1.40 to \$1.50 per box on the eastern market.

Reports from Placer County show that usually the Hachiya brings fifty cents a box more than other varieties although in 1918 the Hyakume and Tanenashi sold equally well. During the 1918 season the net returns from the east averaged about \$1.75 per box, which one grower stated was about double the returns from the San Francisco market.

Cold Storage.—Cold storage of the persimmon is commonly practiced in Los Angeles, the fruit being held for the holiday market when the demand is good. Fruit held longer than the holiday season is liable to move slowly.

Preliminary experiments on the cold storage of persimmons at Berkeley showed that all varieties softened much more quickly at 36° F. than at 32°, and that the fruits kept best at 30°. Most varieties have a tendency to shrivel, especially at the apex and the use of wrapping

paper or even of tight paraffine paper bags is advisable. The following table shows the comparative results with the different varieties:

LENGTH OF TIME IN DAYS
IN WHICH THE FRUIT KEPT IN GOOD CONDITION

Variety	30° F.	32° F.	36° F.
Hachiya (Placer County).....	158	89	51
Hachiya (Orange County).....	141	63	34
Tanenashi (Placer County).....	170	98	30
Maru (Placer County).....	210	189	63
Hyakume (Placer County).....	210	148	63
Mikado (Placer County).....	210	118	30
Tsuru (Orange County).....	106	44	28

The best keeper in the 32° room was Mamegaki, obtained from Chico under S. P. I. No. 13842. It kept 157 days in excellent condition retaining its firmness and glossiness throughout. Specimens of the Tamopan from two different localities unexpectedly showed poor keeping qualities at all three temperatures.

ANALYSES

As early as 1877 Rev. Henry Loomis sent specimens of the persimmon to the California Experiment Station for analysis. (3) A sample received on January 9, 1895 was analyzed with the following results: Average weight, 175 grams; total sugar, 18.2%. The sample contained nearly as much sugar as the fresh French prune with 18.5%, and the Adriatic fig with 19.2% of sugar though it was some 2% below the average California grape in this respect. It was much sweeter than the apricot with sugar at 11.1, the plum with 12.89, and the peach with 12.5%.

Results of investigations made and published in 1903 by the California Experiment Station on the nutritive value of the persimmon are shown in the following table:

ANALYSES OF PERSIMMONS					Carbohydrates		
PERCENT:	Refuse	Water	Protein	Fat	Starch, Sugar, etc.	Crude Fiber	Ash
Large Seedling, edible portion.....		77.04	1.61	.31	19.39	.93	.72
Large Seedling, as purchased.....	22.40	59.77	1.25	.25	15.05	.72	.56
Tanenashi, edible portion.....		81.93	1.16	.55	12.81	2.93	.62
Tanenashi, as purchased.....	1.88	66.53	.94	.45	10.40	2.38	.50
Yemon, edible portion.....		81.66	1.32	.85	13.19	2.37	.61
Yemon, as purchased.....	30.7	56.59	.92	.59	9.14	1.64	.42
Average, edible portion.....		80.21	1.36	.57	15.13	2.08	.65
Average, as purchased.....	23.97	60.96	1.04	.43	11.53	1.58	.49

Notes on the chemistry of the persimmon and several analyses of American and Oriental varieties are given by J. B. McBryde in 1899

(12). The most striking thing shown is the large amount of sugar which is all in the form of glucose. Thorough tests failed to show a trace of cane sugar.

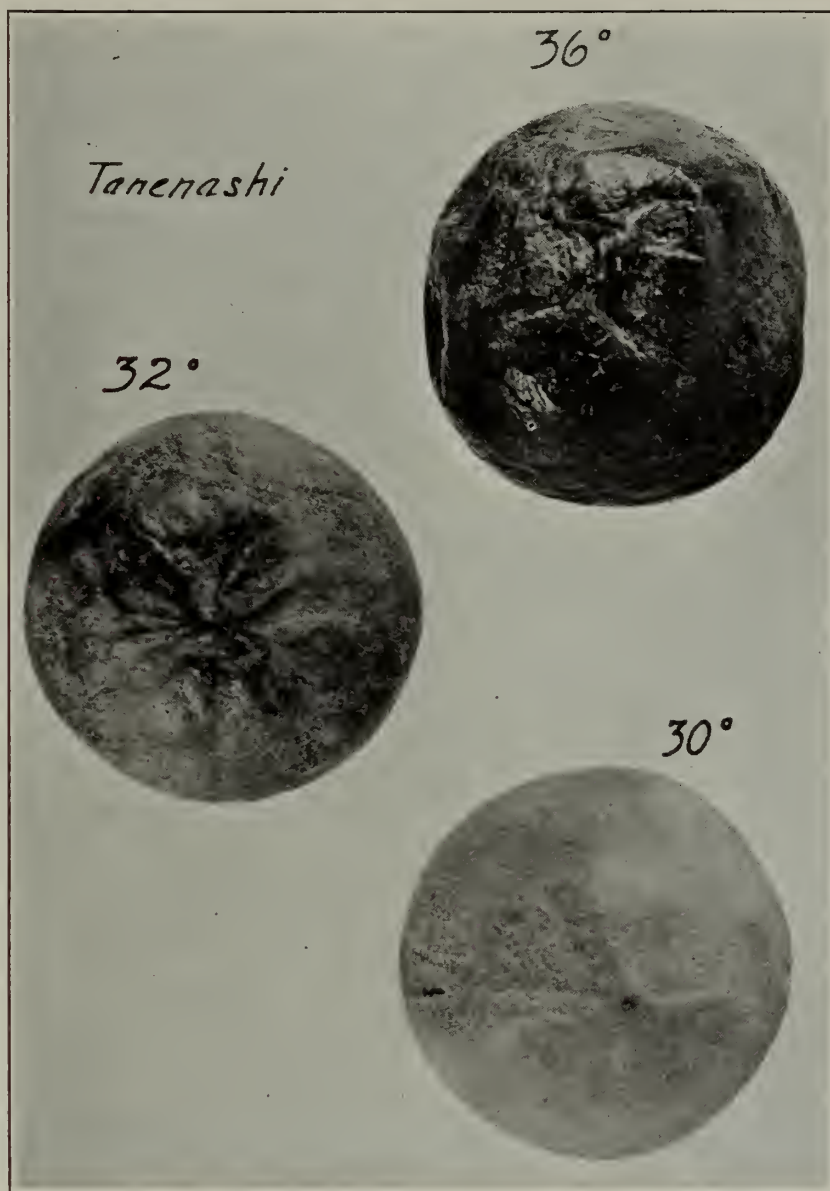


Fig. 20.—The persimmon is well adapted to cold storage and can be held for several months in good condition if kept from shriveling. The fruits keep best at 30 degrees F.

In the United States persimmons are as a rule consumed in the fresh state. The astringent varieties must be allowed to soften thoroughly before they are ready for eating. On account of the difficulty of peeling such soft fruit they may be served satisfactorily at the table whole or in half and the flesh removed with a spoon. Various recipes for puddings, preserves, and other preparations are sometimes offered but the general experience seems to show that the persimmon does not lend itself to such varied dishes as do most other common fruits.

DISEASES AND INSECT PESTS

Persimmon trees are singularly free from serious troubles. There are a few of minor importance, however, which should be considered. A die-back of the trees on heavy soil in Orange County is probably due to soil conditions rather than to any specific fungus.

Crown gall.—In Japanese nurseries crown gall is common on persimmon stock and it has often been found on imported trees. At Chico both the lotus and American stock have been affected and in 1918 the greater part of the trees in one nursery were destroyed owing to such infection. The only recourse in such cases is to avoid planting in infected soil.

Several other serious fungus diseases attack the twigs, foliage and fruit of the persimmon in Japan but none have so far become established in California.

Insects.—In Japan a worm, *Kakivoria flavofasciata*, analogous to the codling moth of the apple, does considerable damage in some districts. Sweet varieties are more subject to attack than astringent and it is often necessary to bag the fruit to insure perfect specimens.

In New South Wales, Australia, persimmons were at one time quite largely planted near Sydney but on account of the depredations of fruit flies the trees were grubbed out. In recent years, certain methods of controlling the fruit fly have been developed, and persimmons are again being planted. These two records of insect pests emphasize the need for strict quarantine measures to prevent their introduction into California.

The most serious insect pest of the persimmon in the Southern States is the twig girdler *Oncideres cingulata*. Its infestations have deterred some people from planting trees extensively. The white peach scale, the San Jose scale, the twig girdler, and the orange white fly attack the tree in Florida.

A few trees out of forty thousand imported into this state from Japan early in 1919 were found upon inspection to be infested with the eggs of the Japanese Cicada, Mantis eggs, and an occasional Pseudococcus. The trees showing infestation were destroyed. Some stock imported under permit from Florida and Texas were found to contain a large borer, supposed to be *Sannina uroceriformis*, and the trees were also destroyed.

In California the barnacle scale and the white peach scale have been found on the persimmon tree but neither is serious. In Placer County the attacks of a larva, probably that of the codling moth, causes Maru fruits to ripen and drop prematurely. At the University Farm, Davis, the larvae of the red-humped caterpillar, *Schizura concinna*, appear to be fond of persimmon leaves and, unless controlled, defoliate the trees.

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